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REPORTS OF OBSERVATORIES.

Manuscript intended for this department should be sent to FRANK SCHLESINGER, Yerkes Observatory, Williams Bay, Wis.

NAVAL OBSERVATORY, WASHINGTON, D. C.

During the year 1903 the following changes have taken place in the personnel:—

Mr. T. I. KING, assistant astronomer, was transferred to the Nautical Almanac Department December 1st, at which date Mr. J. C. HAMMOND was promoted to fill the vacancy thus caused.

The instruments have been used as follows:—

The 6-inch transit-circle was devoted to the routine observations of the Sun, Moon, and planets up to September 4th, when the work was transferred to the 9-inch transit-circle, thus permitting the consideration of certain changes and additions to the instrument.

The 9-inch transit-circle, after the completion of extensive repairs and improvements, was put into commission September 3, 1903, and has since been used for the fundamental determination of the Right Ascension and Declination of the Sun, Moon, planets, and the stars of NEWCOMB'S Fundamental Catalogue, GILL'S Zodiacal Catalogue, and the Zodiacal Catalogue of the U. S. Nautical Almanac Office, now in press.

A new clock by RIEFLER, of Munich, in an air-tight glass case, with nickel-steel pendulum and electrical winding, was installed September 1st, and has been used since that date as the standard sidereal clock.

The prime vertical transit-instrument has been devoted to continuing observations for the determination of aberration, nutation, and variation of latitude and to the determination of the declinations of 390 miscellaneous stars.

The altazimuth instrument has been devoted to a determination of the latitude of the observatory and the declinations of 350 standard stars.

Photographs of the Sun have been obtained with the photoheliograph on every clear day.

The equatorials have been devoted to measurements of the diameters of the planets, and to the observations of the satellites, asteroids, comets, and occultations. Photography has been used in detecting the location of most of the asteroids which have been observed.

During the year 1903 the following volumes have been published: Volume III, *Publications of the U. S. Naval Observatory,* Second Series, containing observations of *Eros* and the reference-stars, observations of zodiacal stars and prime vertical observations 1882-1884; Volume V, *Meteorological Observations and Results, 1893–1902.* Volume IV is now in press.

Good progress has been made on the formation of the Catalogue of the Astronomische Gesellschaft Zone, — 13° 50′ to — 18° 10′, as well as on the cataloguing of the Washington zones 1846–1852.

The practical naval features of the observatory work are seen in the regular publications of the American Ephemeris and Nautical Almanac, and the purchase, trial, and issue to the naval service of chronometers, watches, sextants, telemeters, binoculars, surveying and photographic outfits, and all navigational instruments, except compasses. The time-service maintained in connection with the chronometer service sends out daily, except Sundays and holidays, telegraphic noon-signals that reach all points in the country, correcting some 40,000 clocks, and dropping sixteen time-balls.

The following articles by members of the Observatory staff have appeared during the year 1903:—

Elements and Ephemeris of Comet *a* 1903 (Giacobini), by H. R. Morgan and Eleanor A. Lamson (*A. J.* 530 and *A. J.* 531-532).

Observations of Heliometer Comparison-Stars, by M. Updegraff and J. C. Hammond; Observations of Minor Planets, by J. C. Hammond; Observations of Comet *b* 1902 (Perrine), by C. W. Frederick and W. W. Dinwiddie (*A. J.* 533).

Observations of the Declinations of *Vesta,* by George A. Hill; Observations of the Right Ascensions of *Vesta,* by Everett I. Yowell (*A. J.* 534).

Observations of Comet 1900 II, by George K. Lawton (*A. J.* 535).

Observations of Comet *a* 1903 (Giacobini), by C. W.

FREDERICK; Observations of TURNER'S *Nova* (2387 *Geminorum*), by C. W. FREDERICK; Photographic Observations of the Minor Planet (60) *Echo,* by G. H. PETERS; Photographic Observations of Minor Planets, by G. H. PETERS (*A. J.* 537-538).

Observations of Minor Planets, by J. C. HAMMOND (*A. J.* 540-541).

Observations of the Satellite of *Neptune* and Comet *d* 1902 (GIACOBINI), by W. W. DINWIDDIE; Observations of Minor Planets, by J. C. HAMMOND; Observations of Comet *b* 1902 (PERRINE), by C. W. FREDERICK (*A. J.* 542-543).

Observations of BROOKS'S Comet 1889 V, by C. W. FREDERICK; Observations of Minor Planets, by J. C. HAMMOND (*A. J.* 547).

Observations of Comets and Minor Planets, by T. I. KING; The Instrumental Constants in Equatorial Work, by C. W. FREDERICK (*A. J.* 552).

Chronometer-Rates, by Lieut.-Commander E. E. HAYDEN (*Proceedings Naval Institute,* Vol. 29, No. 3).

The Pivots of the 9-inch Transit-Circle of the Naval Observatory, by W. S. EICHELBERGER (*Astron. and Astroph. Soc.,* December, 1903).

C. M. CHESTER, *Rear Admiral, U. S. N.,*
Superintendent Naval Observatory.

KIRKWOOD OBSERVATORY, BLOOMINGTON, IND.

As this observatory is a part of Indiana University, it seems necessary at present that the major part of the time and energy of the corps of instructors be devoted to teaching. This affects in a serious manner the quantity, certainly, and perhaps the quality, of research work done here. However, at least the first half of every clear night is devoted to work with the telescopes. A part of this time is used by students more or less advanced, whose work, though done seriously, is in the main that of amateurs.

During the past two years we have measured about three hundred pairs of double stars, which have been selected from those noted as double by observers while making the A. G. catalogues, and which have not been hitherto measured. The measures of two of these lists have already been published, and two other lists are now in manuscript. The measures were made with the 12-inch refractor to which is attached a micrometer by WARNER & SWASEY. With the same instrument we obtained a large number of positions of Comet *d* 1902 and Comet *a* 1903.

A mounting for a 15-inch reflector, the mirror of which was kindly loaned us by Mr. O. L. PETITDIDIER, of Chicago, has just been completed by the department. With this instrument a series of photographs of nebulæ and star-clusters has been made. With a portrait-lens of five inches aperture and with a small "tintype" lens a fairly complete series of photographs of BORRELLY's Comet was obtained. Using a color-screen, we have succeeded in making with the refractor quite excellent photographs of the Moon.

JOHN A. MILLER, *Director.*

CHAMBERLIN OBSERVATORY, DENVER, COLO.

During the year 1903 only comet observations were made, the time of the director of the observatory being largely consumed by administrative work in connection with the University of Denver. H. A. HOWE, *Director.*

THE ASTROPHYSICAL OBSERVATORY OF THE SMITHSONIAN INSTITUTION, WASHINGTON, D. C.

Bolographic studies of the spectrum of the Sun and the provision of a large horizontal telescope to be used for studies of special portions of the solar radiation have been the distinguishing features of the work of the Astrophysical Observatory during the past year. Results of uncommon interest have been reached in the bolographic work of the past twelve months, and especially in the studies of the absorption of the solar rays by our atmosphere.

Briefly this has shown that the Earth's atmosphere, so far as it can be observed here, has been more opaque than usual within the present calendar year, so much so as to reduce the direct radiation of the Sun at the Earth's surface by about ten per cent, on the average, throughout the whole visible and infra-red spectrum, and by more than double this amount in the blue and violet portions of the spectrum. This alteration of the transparency of the air has not, however, been confined to the region of Washington.

Another interesting observation is that determinations of the rate of solar radiation outside the Earth's atmosphere might appear to indicate that there has been a decrease of the solar radiation itself since March 26, 1903; but I refer to this with hesitation, as I have elsewhere observed that it is scarcely possible to be certain of the accuracy of results of this sort when based on observations near sea-level. The value of a solar observatory at a high altitude, to which I referred last year, can hardly be overestimated.

A new determination of the temperature of the Sun, based on the distribution of the solar radiation in the spectrum, has yielded a result of 5,920° of the centigrade scale above absolute zero.

For the purpose of the special study of the nature of sun-spots, the absorption of the solar gaseous envelope, and for other observations requiring a large solar image an equipment including a horizontal reflecting telescope of 140-foot focus and 20-inch aperture and a cœlostat of improved construction to furnish at all times a 20-inch horizontal northerly directed solar beam has been provided. The form of cœlostat employed seems so well suited to solar work that this large instrument will be exhibited by the observatory at the Louisiana Purchase Exposition in 1904. Provision has been made in connection with the long-focus telescope to churn the air traversed by the beam from the cœlostat to the focal image after the manner described in my last year's report. It is hoped that this installation will have yielded results of interest before another year.

On the whole, the work of the Astrophysical Observatory during the past year has been quite as productive of results of interest as during any former year of its existence, especially in showing a notable variation of atmospheric transparency which is likely to have affected climate and the growth of vegetation over a considerable part of the Earth's surface, and in the studies of atmospheric absorption and those relating to the solar constant, to which I have referred, there seems renewed promise of progress toward the goal "foretelling by such means those remoter changes of weather which affect harvests," which is one of the great aims had in view in the foundation of the observatory.

S. P. Langley,
Secretary of the Smithsonian Institution.

CINCINNATI OBSERVATORY, CINCINNATI, OHIO.

The work of this observatory during 1903 has been along the same lines as in the year previous. Observations for the variation of latitude were carried on with as great regularity as the weather would permit, 1,490 pairs having been obtained. The reobservation of the stars of Piazzi's catalogue north of the equator with the meridian-circle was practically completed. It is hoped during the current year to publish the results.

Last summer the 11-inch equatorial, originally purchased by Professor Mitchel, was dismounted. For nearly thirty years it stood on Mount Adams, a high prominence overlooking the city, and named in honor of John Quincy Adams, who delivered the oration at the laying of the corner-stone of the Cincinnati Observatory. For thirty years more the telescope has stood upon Mount Lookout, six miles northeast of the city. It is hoped soon to remount this historic instrument, the oldest of any considerable size in the Western Continent.

In the mean time the observatory has purchased of the Alvan Clark Corporation a new 16-inch equatorial, which will be installed early in the year. It is then expected to take up some lines of extra-meridian work.

J. G. Porter, *Director.*

HARVARD COLLEGE OBSERVATORY, CAMBRIDGE, MASS.

East Equatorial.—Nearly all of the observations with this instrument have been made by Professor O. C. Wendell, and have been of the same general character as in previous years. The errors of observation have an average value of three or four hundredths of a magnitude. Deviations of a tenth of a magnitude generally indicate real changes in the star measured. The effect of color also seems less troublesome than with visual observations. About two thousand measures have been made of stars suspected of variability by other observers. An attempt is made to measure, every year, all stars which vary more than half a magnitude an hour, on three nights when increasing in light, and on three when decreasing in light. About six thousand measures have been made of such objects. Seven hundred measures have also been made with a second photometer adapted to the comparison of stars too near together to be measured with the first instrument. The same instrument has been used in the photometric measurement of *Jupiter's* satellites while undergoing eclipse. Observations of variable stars of long period throughout their changes, and the reduction of the results to the scale of the meridian photometer have been continued.

Similar observations of variables and comparison-stars have been made with the *West Equatorial.* With it 1,724 estimates of variables and 399 of comparison-stars have been made by Miss CANNON. Three thousand three hundred and ninety-five estimates of variables, and 323 estimates of comparison-stars have been made by Mr. CAMPBELL with the naked eye, field-glass, and a 5-inch portable telescope. Some estimates of faint variables and photometric measurements of double stars were also made by Mr. CAMPBELL during the month of August, with the *East Equatorial.*

Meridian Circle.—The only important work of this instrument during the year has been the determination of clock-error. All the columns of the catalogue of stars belonging to the zone — 9° 50′ to — 14° 10′ are now provisionally complete, except that current numbers are not yet assigned to the stars. The work of re-computing particular observations, in cases of large discrepancy, is also very nearly finished.

12-inch Meridian Photometer.—The principal work has been the completion of observations undertaken in previous years, and the measurement of all the Durchmusterung stars in zones 10′ wide, north of Declinations — 5° and — 15°. A beginning has been made of the observations of stars in similar zones south of + 5°, + 15°, and + 25°. This work will supplement that already completed at Declinations — 20°, — 10°, 0°, + 10°, etc. Measures have also been made of sequences of stars from the eighth to the thirteenth magnitude, in twenty-three coarse clusters, to determine the absolute magnitudes of the components of these objects. By interposing a shade-glass so as to reduce the light of the star, any star however bright could be measured. Another modification of the instrument permitted surfaces to be measured.

Henry Draper Memorial.—Eight eclipses of *Jupiter's* satellites, and five occultations, have been successfully photographed with the 11-inch Draper telescope. Four variable stars have been found by Mrs. FLEMING, and one by Miss BRESLIN, from the examination of the Draper photographs. Among other photometric investigations of plates, it was found that a reduction of temperature from 70° to 0° F. increased the sensitiveness of plates by about half a magnitude. Photographic charts have been made here of the regions of asteroids which have not been observed elsewhere during the last three years. Several asteroids have thus been found, but owing to the faintness of the greater portion of these objects the 8-inch Draper telescope, which was the instrument employed, is hardly large enough for this work.

Boyden Department (Arequipa).—Measures have been made on 21 nights, with the meridian photometer, in extending to the South Pole the system of bright standard stars, one in each ten degrees square. Many measures were made with the Rumford photometer attached to the 13-inch Boyden telescope. Notwithstanding its faintness, the variations in the light of *Eros* have thus been measured by Professor BAILEY from March 30th to August 19th. Excellent curves have been obtained which show a variation in the range from about half a magnitude to a magnitude. Observations of fifty southern variables have been made, besides a careful study of their comparison-stars.

Bruce Photographic Telescope.—The number of photographs taken with the Bruce photographic telescope was 413. Although these plates are difficult to handle and liable to be broken, owing to their size, which is 14 by 17 inches, yet they are proving extremely useful, since by their aid stars may be studied which are much too faint to be photographed with our other instruments. The scale also permits positions to be determined much more accurately than with smaller instruments. Forty-two of these plates had exposures of one hour, and showed the spectra of the stars; the remainder were chart-plates, of which 17 had exposures of four to five hours, 66 of one hour, 166 of ten minutes; 87 were of the planet *Eros,* and 35 were miscellaneous. Mr. FROST, from an examination of 18 photographs, found 37 nebulæ not contained in DREYER'S catalogue. On one plate he counted 10,926 stars in one square degree.

Miscellaneous.—The reduction of the observations made by the late Professor ROGERS with the meridian-circle, during the years 1879 to 1883, is being continued by Miss BOND. Mrs. FLEMING has not been able for some time to continue the classification of spectra for the Southern Draper Catalogue. Arrangements have now been made so that she is doing this work at home in the evening. A stereocomparator has been constructed and gives satisfactory results. The Revised Harvard Photometry, containing about nine thousand stars, is now approaching completion. All stars in any part of the sky and of the magnitude 6.5 and brighter in any of our photometric catalogues are included. The anonymous gift of 1902 has been of the greatest service; it will provide two reflectors of twenty-five inches aperture, one for use on the northern and the other on the southern stars, and has given us a fire-proof wing to the building already used for storing and studying the photographs. The cost of the entire building and wing was only about $20,000, and two similar buildings would provide for a much needed new library for the observatory, computing-rooms, photographic laboratory, and a workshop.

EDWARD C. PICKERING, *Director.*

THE WASHBURN OBSERVATORY, MADISON, WIS.

During the year 1903 the 40^{cm} equatorial telescope was employed by the Director in the following series of observations: (*a*) Micrometric observations for the determination of the parallax and proper motion of *Nova Persei.* This series, commenced immediately after the appearance of the *Nova,* will be continued at epochs of maximum and minimum parallactic effect so long as is feasible. (*b*) Micrometric observations of a selected list of binary stars known to be in relatively rapid motion. This work is in continuation of the observations contained in *Publications* of the Washburn Observatory (Vol. X). (*c*) The remeasurement of a list of wide double stars first observed a half-century since by the STRUVES. (*d*) Experiments to determine the adaptability of the telescope to celestial photography as a substitute for the micrometer.

The amount of work accomplished along these several lines has been considerably restricted by unfavorable atmospheric conditions, and in even greater measure by a large increase in the purely academic duties of the Director. Although no clerical assistance is available in connection with this work, the reductions of all observations have been completely made, and the observations of the binary stars are ready for publication. The observations of *Nova Persei,* while individually reduced, still require a discussion that can be given only when the series is complete.

The observations above noted under the rubric (*c*) were undertaken with a view to the determination of the proper motions of faint stars (8 to 12 magnitude), and the observing list is intended to include all stars of this character that have been compared by the STRUVES with bright stars of known proper motion. For a provisional account of the results already obtained, together with some discussion of their bearing upon current theories of the constitution of the stellar system, reference may be made to the *Astronomical Journal,* No. 558.

The meridian-circle of 12.2^{cm} aperture was employed during the year 1903 by Mr. A. S. FLINT in observations for the determination of stellar parallax. These observations, beginning July 15, 1898, constitute a second series substantially similar to the first series of parallax determinations, contained in *Publications* of the Washburn Observatory (Vol. XI), save that in their conduct a Repsold transit-micrometer has been employed. The reader may consult the *Astronomical Journal,* No. 470, for an account of the observer's earlier experience with this micrometer and with the peculiar system of slat screens employed for diminishing the apparent magnitudes of the stars observed. The result of five years' additional experience is on the whole favorable to the apparatus, when employed, as is here done, with close parallel threads, between which the star's image is held during transit. After some experimentation the observer has adopted $10''$ as approximately the most convenient distance between these threads.

The observing list of stars whose parallaxes are to be determined is made up as follows:—

Stars brighter than magnitude 1.5	1
Stars between magnitudes 1.5 and 2.5, inclusive	41
Stars between magnitudes 2.6 and 3.1, inclusive	26
Fainter stars of large proper motion	36
Binary stars	18
Miscellaneous stars	2
Total	124

It was the original intent to include in this list all stars between the magnitudes 1.5 and 2.5 that were within the reach of the instrument, and the number 41, above given, represents approximately two thirds of all stars of this class in the entire sky.

Observations of 66 stars of the foregoing list are now completed, with an average of 73.4 observations per star, including in most cases two comparison-stars for each star whose parallax is to be determined. Early in the progress of the work preliminary solutions were made in the case of six parallax stars, having an average of 53 observations per star, and from these it appears that the average probable error of a parallax thus determined is ± 0″.032. The individual parallaxes thus determined were + 0″.01, + 0″.04, + 0″.05, + 0″.26, — 0″.02 — 0″.01.

Through the courtesy of the trustees of the Gould Fund of the National Academy of Sciences a grant of $400 has become available during the past year in aid of the reduction of these observations, and has considerably facilitated the work. The present state of the reductions is represented by the statement that, for the observations already made, approximately one half of the computing required to produce the absolute terms of the resulting observation equations is completed.

The parallax observations being in an advanced state, Mr. Flint undertook, in October, 1903, and is now actively carrying on, the determination of the positions of a list of stars observed by the Director as comparison-stars in the work above designated (*c*). These are for the most part stars of moderate brightness, for the determination of whose proper motions modern observations are greatly needed.

Aside from the current determination of time, the transit-instrument and the small equatorial telescope of the observatory have been used only for purposes of instruction.

March 10, 1904. George C. Comstock, *Director.*

INTERNATIONAL LATITUDE STATION, UKIAH, CAL.

The programme of the International Geodetic Association for observing variations of latitude was continued throughout 1903 without modification or interruption. Dr. Schlesinger's connection with the station ceased on April 30th, and mine began on February 1st. Very good observing weather prevailed during nearly the entire year. The longest intervals without observations were nine nights in January, and again nine nights in December. December, however, yielded a unique record—sixteen complete (no incomplete) nights' work. Between November 29 and January 21, 1904, an unbroken record of twenty-eight complete nights was obtained. The total number of pairs observed was 2,655, which exceeds by 552 pairs the best previous record. The distribution by months is as follows:—

		Pairs.			Pairs.
1903.	January	155	1903.	July	209
	February	257		August	222
	March	161		September	200
	April	309		October	238
	May	261		November	172
	June	215		December	256

During the three months that Dr. Schlesinger and I observed together the nights were about equally divided between us, the plan being to determine the personal difference between the two observers. For this purpose 650 pairs were obtained, and a preliminary reduction of these gives a difference between results of the two observers of but $0''.01$, $\phi_S - \phi_T = + 0''.01 \pm 0''.01$.

Sidney D. Townley.

VASSAR COLLEGE OBSERVATORY, POUGHKEEPSIE, N. Y.

During the past year the observatory of Vassar College has been occupied with the reduction of photographic plates covering the region about the North Pole. With the grant from the Carnegie Institution, two computers were engaged, who are still employed, and during the summer months the number was increased by two, one of whom had had considerable experience in such computation.

The reduction of the separate plates and their interadjustment have been completed, and the final catalogue is nearly ready. There remains still the determination of the proper motions, for which a large amount of material has already been collected. Of the stars on the plates, 31 are found in SCHWERD, 165 in CARRINGTON, 78 in the observations of FABRITIUS at Kiev, and 60 in the Greenwich observations for 1899 and 1900. Scattering observations are found in a number of other catalogues. With but few exceptions, the proper motions of these stars have never been determined.

During the past year a photometer, with a photographic wedge after the Harvard pattern, has been added to the equipment of the observatory, and has been used by Professor WHITNEY for observing variable stars.

The regular work of observing asteroids and comets has been omitted this year, since the computing force has been exclusively occupied with the plate-work.

The instruction which forms the principal work of the observatory force has continued as heretofore.